

Export Spillovers of FDI on China's Domestic Firms\*

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Abstract

This paper examines the horizontal and vertical export spillovers of foreign direct investment (FDI) on China's manufacturing domestic firms by using firm-level census data over the period of 2000–03. Based on a Heckman two-step procedure combining first differencing and instrumental variable regression techniques, we find that FDI has had a positive impact on the export value of domestic firms mainly through backward technology spillovers and a positive impact on the export-to-sales ratio of domestic firms through horizontal export-related information spillovers. After decomposing FDI by different market orientation and domestic firms by different ownership, we find that the positive impact on domestic firms' export values is mainly from the non-exporting and the exporting foreign-invested enterprises while the positive impact on domestic firms' export-to-sales ratios is mainly from the high-exporting foreign-invested enterprises. Both types of export spillovers are mainly diffused to domestic non-state-owned enterprises.

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## 1 Introduction

Since late 1978, China has encouraged export-oriented foreign direct investment (FDI). As a consequence, a large number of foreign-invested enterprises (FIEs) that specialise in processing exports have been established. At the same time, domestic Chinese firms' export performance has increased significantly in terms of the number of exporting firms, firms' total export value, and firms' average export-to-sales ratio. The main interest in this paper is to investigate and identify whether and how FDI has contributed to Chinese domestic firms' enhanced export performance.

Using firm-level census data of Chinese manufacturing industries over the period 2000-03, this paper investigates the impacts of FDI on domestic Chinese firms' export values and export-to-sales ratios. The paper first examines the impact of FDI presence on domestic firms' export decisions by employing a probit model with cross-sectional data. Next, export spillovers through horizontal and vertical industrial linkages between FIEs and domestic firms are investigated. In addition, we examine the impact of FIEs with different market orientations on domestic firms' export performance, as well as the impact of FDI presence on export performance of domestic firms with different types of ownership.

We find that, through the mechanism of export-related information spillovers, FIEs have a positive impact on the export *decisions* of domestic firms in the same industry and that, through the mechanism of backward technology spillovers, FIEs have a positive impact on the export decisions of domestic firms in upstream industries. We find, however, that FIEs have a negative impact on the export decisions of domestic firms in downstream industries, something which we suggest might be caused by competition from FIEs. We also find that, through the mechanism of backward technology spillovers, FIEs have a positive impact on the export *values* of domestic firms (mainly those in upstream industries) and that FIEs have, through the mechanism of horizontal export-related information spillovers, a positive impact on the export-to-

sales ratios of domestic firms in the same industry. The positive impact on domestic firms' export values is found to be from both non-exporting FIEs and exporting FIEs, while the positive impact on domestic firms' export-to-sales ratios is found to be mainly from high-exporting FIEs. Finally, we find that both backward technology spillovers and horizontal export-related information spillovers are more likely to be observed in domestic enterprises that are not state-owned.

The next section discusses the spillovers from FDI that may affect domestic firms. Section 3 discusses the data set used here and sections 4 and 5 present the model and the results.

## **2 Export Spillovers From FDI: Theory and Literature**

FDI may affect domestic firms' export decisions and export performance through technology spillovers and export-related information spillovers (Kneller and Pisu, 2007; Fu, 2011). Technology spillovers will improve productivity and competitiveness and increase the export values of domestic firms in upstream and downstream industries, while export-related information spillovers will reduce export marketing costs and increase the export-to-sales ratios of domestic firms in the same industry.

Technology spillovers can be horizontal (within the same industry) through demonstration effects and labour movement. However, FIEs can also impose competition on domestic firms, crowd them out from the product market, and compete with them in the labour and resources markets (Aitken and Harrison, 1999; Hu et al., 2005). The assessment of the *net* effects of horizontal technology spillovers of FIEs on domestic firms is thus far inconclusive (Gorg and Greenaway, 2004). Technology spillovers can also be vertical, through forward and backward industrial linkages (e.g., Javorcik, 2004; Kneller and Pisu, 2007) within the supply chain. When FIEs provide better intermediate materials for their customers or when they transfer knowledge to their suppliers for better quality final products, domestic firms in upstream and

downstream industries can benefit in productivity and competitiveness thus increase their exports.

Export-related information spillovers may take place through demonstration effects and labour movement (Aitken et al., 1997). Exporting involves sunk costs. These might include the establishment of distribution and logistics channels, product compliance and regulations, and market research to acquire information about consumer tastes and market structure in foreign countries (Melitz, 2003; Bernard and Jensen, 2004). Export-related information spillovers can lower the sunk costs associated with export market entry so that the marginal firm finds it profitable to start exporting. They can also reduce existing exporters' marketing costs to extend their export markets, thus increasing domestic firms' export-to-sales ratios or export market orientation (Kneller and Pisu, 2007).

The literature on export spillovers from FDI is limited compared to that on productivity spillovers (Gorg and Greenaway, 2004). Aitken et al. (1997) were pioneers in exploring externalities associated with FDI. Using plant-level cross-section data for Mexican manufacturing industries for 1986 and 1989, they find that domestic firms' export probability increases with the concentration of exports of multinational enterprises (MNEs) operating in the same industry and region. Kokko et al. (2001), using cross-sectoral firm-level data for Uruguay for 1998, also find that export-oriented MNEs positively affect the probability that domestic firms will export. Sjöholm (1999), using data for Indonesian manufacturing firms, finds that FDI in Indonesia had no significant effect on exports by domestic firms.

Greenaway et al. (2004), using firm-level panel data for the United Kingdom for the period 1992–96, find that MNEs' exports have a positive effect on domestic firms' export probability but that they do not affect domestic firms' export-to-sales ratios. Ruane and Sutherland (2005), using firm-level panel data in Ireland for the period 1991–98, find that a domestic firm's export decision is positively associated with the

presence of MNEs. However, they find that MNEs' export intensity is negatively associated with domestic firms' export decisions and export intensities. Barrios et al. (2003), using firm-level panel data for Spanish manufacturing for the period 1990–98, find no evidence that MNEs' export activity affects either the probability that domestic firms will export or their export-to-sales ratios.

In the context of China, Buck et al. (2007), using firm-level panel data for the period 1998–2001, find that MNEs positively affect local Chinese firms' exports. Sun (2009), using data for the Chinese cultural, educational, and sporting products industry between 2000 and 2003, finds some positive effects of FDI on domestic firms' exports in this industry, although the impacts are asymmetric across regions and differ among firms of different types. Fu (2011) examines the impact of processing-trade related FDI in China on the export competitiveness of domestic firms using firm-level data for the period 2000–07. The results show that processing-trade related FDI has generated positive information spillover effects on domestic firms' export performance, but that technology spillovers exert a significant depressive effect on the probability that these domestic firms will export.

Thus far, most literature has concentrated on *horizontal* export spillovers, except Kneller and Pisu (2007) who examine export spillovers from MNEs to domestic firms through horizontal, backward, and forward linkages in the United Kingdom. Using firm-level data from 1992 to 1999, they find that domestic firms' export decisions are only affected by MNEs through backward spillovers. In terms of the impact on domestic firms' export-to-sales ratios, they find that the horizontal spillovers are more likely to depend on MNEs' export orientation. With regard to vertical spillovers, they find significant negative forward and positive backward export externalities.

Despite this research, the evidence of how FDI affect domestic firms' export decisions and export performance remains limited. This paper aims to re-examine this issue by using firm-level data from Chinese manufacturing industries.

### **3 Data Collection and Variable Definition**

The annual enterprise census conducted by China's National Bureau of Statistics (NBS) covers the population of all state-owned enterprises (SOEs) and non-state-owned enterprises (non-SOEs) in Chinese manufacturing industries that have annual sales values above RMB5 million yuan (around US\$0.8 million). The sample is an unbalanced dataset at the firm level for the period 2000 to 2003. The total number of firms covered varies from 134,130 in 2000 to 169,810 in 2003. The change in the number of firms over time is caused by firms' entry and exit.

To distinguish between domestic firms and FIEs, we use data from the China Enterprise Registration Code (CERC) about both firms' ownership information and their capital composition. Domestic firms are defined as currently operating firms registered as non-foreign-invested firms (CERC 100-190) and with a foreign capital share of less than 25% of their total registered capital. FIEs are defined as those currently operating firms registered as foreign-invested firms (CERC 200-340) and with a foreign capital share of more than or equal to 25% of their total registered capital. Domestic firms with no foreign investment (i.e., 100% domestically-owned firms) are also used for similar exercises for a robustness check.

The dependent variables here are export decisions and indicators of export performance. A firm's export decision is defined as a dummy variable, which takes the value of one if the firm exports in a given year or zero otherwise. For export performance, most studies use the export-to-sales ratio (e.g., Barrios et al., 2003; Buck et al., 2007; Greenaway et al., 2004; Kneller and Pisu, 2007; Ruane and Sutherland, 2005; Sun, 2009) while some studies (e.g., Fu, 2011) use the export value as the dependent variable to investigate the impact of FDI on domestic firms' export performance. Both the domestic firms' export values and export-to-sales ratios are used here. A domestic firm's export value is defined as the current value of that domestic firm's export revenue deflated by the firm-level output price index (OPI) at 2000

constant prices, while a domestic firm's export-to-sales ratio is defined as its export revenue divided by its total sales revenue.

A firm's export value reflects its export competitiveness, while its export-to-sales ratio reflects its export market orientation (Fu, 2011). If domestic firms' productivity and competitiveness are improved through technology spillovers from FIEs, domestic firms will increase their export values but may not necessarily increase their export-to-sales ratios if their market orientation toward domestic and international markets does not change. This is because the increase in productivity and competitiveness may lead to a proportionately equivalent increase in domestic and international sales. On the other hand, if export marketing costs are reduced through export-related information spillovers from FIEs, even though there is no change in domestic firms' productivity and competitiveness, domestic firms can change their market orientation from domestic markets toward international markets, thus increasing their export-to-sales ratios. This is because the marketing costs of international sales have been reduced relative to those of domestic sales.

This paper defines three measures of FDI presence by using both the capital stock and the output value of FIEs at the industry level. These measures of foreign presence take account not only of the relative importance of FIEs' physical capital, in which the advanced technology used by FIEs is embedded, but also FIEs' production and business activities, through which the demonstration effects and information spillovers of FIEs are generated. In addition, the use of both capital *and* output in the calculation of the measures for foreign presence could avoid bias in the estimation of FDI spillovers when either capital or output alone is used for the measures. As an example, Gorg and Strobl (2001) find that estimates of spillovers tend to be lower if capital shares, rather than output or employment shares, are used.

Following Javorcik (2004), the variable of FIEs' horizontal spillovers is defined as the weighted sum of each FIE's share of foreign fixed capital stock, with the weight being each FIE's share in the industry's total output ( $Horizontal_{jt}$ ):

$$Horizontal_{jt} = \left( \sum_{i \in j} ForeignShare_{it} * Y_{it} \right) / \left( \sum_{i \in j} Y_{it} \right), \quad (1)$$

where  $ForeignShare_{it}$  denotes the share of foreign fixed capital stock in an FIE  $i$  at time  $t$  and  $Y_{it}$  is the total output of the same FIE at the same time. The value of this variable increases with increases in FIEs' output and with the share of foreign fixed capital stock in these FIEs. The variable of backward spillovers is defined as:

$$Backward_{jt} = \sum_{k \neq j} \alpha_{jk} Horizontal_{kt}, \quad (2)$$

where  $\alpha_{jk}$  is the proportion of industry  $j$ 's output supplied to industry  $k$ , and is taken from China's 2002 input-output (I-O) table at the two-digit level of the Chinese Industrial Classification Code (CICC). The greater the foreign presence in industries supplied by industry  $j$  and the larger the share of intermediates supplied to industries with FDI presence, the higher the value of the variable. The variable of forward spillovers is defined as:

$$Forward_{jt} = \sum_{m \neq j} \varphi_{jm} \left[ \sum_{i \in m} ForeignShare_{it} * (Y_{it} - EX_{it}) \right] / \left[ \sum_{i \in m} (Y_{it} - EX_{it}) \right], \quad (3)$$

where  $\varphi_{jm}$  is the share of inputs purchased by industry  $j$  from industry  $m$  in total inputs sourced by industry  $j$ . It is also taken from China's 2002 I-O table at the two-digit level.  $EX_{it}$  denotes the export value of FIE  $i$  at time  $t$  estimated with the output constant price. As only intermediates sold in the domestic market are relevant to this study, goods produced by FIEs for exports  $EX_{it}$  are excluded. The greater the foreign presence in industries sourced by industry  $j$  and the larger the share of intermediates sourced from industries with FDI presence, the higher the value of the variable.

Regarding the construction of backward and forward linkages of FDI, Barrios et al. (2011) argue that the method proposed by Javorcik (2004) depends on a number of

restrictive assumptions which if violated lead to bias Barrios et al. (2011) suggest adding FIEs' imports into the host country's I-O table or using the international I-O table or the home country's I-O table as a substitute but lack of data prevents us from making this adjustment. .

We control for some firm characteristics affecting domestic firms' export performance, including productivity, the capital-labour ratio, research and development (R&D) activities, firm scale, age, and indirect foreign investment.

For domestic firms' productivity, we use domestic firms' total factor productivity (*TFP*) as an approximation to control for the possible impact of productivity disparity on firms' export performance (Melitz, 2003). Following Levinsohn and Petrin (2003), TFP is estimated by using the semi-parametric regression method. Productivity is expected to have a positive impact on domestic firms' export performance.

A firm's capital-labour ratio (*K/L*) is defined as the net value of fixed assets at year 2000 constant prices divided by the total number of employed workers, which is used to control for the impact of comparative advantage disparity across firms on their export performance. Given China's comparative advantage in labour-intensive activities, the capital-labour ratio is expected to have a negative impact on domestic firms' export performance.

A firm's *R&D* index is defined as the total revenue from new products divided by the firm's total revenue. This represents a domestic firm's innovation ability and is used to control for the impact of technology differences on firms' export performance. R&D activities can increase competitiveness and therefore are expected to have a positive impact on domestic firms' export performance.

A firm's age is estimated by using its opening (establishment) year (*OpenYear*). A firm's scale is a dummy variable (*D\_Scale*), which takes a value of one if the domestic firm is classified as a large or medium-sized firm and zero if it is not. We have

no expectation about the impact of these two variables on domestic firms' export performance.

Indirect foreign investment (*IFI*) is domestic firms' foreign equity share in total registered capital and ranges from zero to less than 25%. This variable controls for the direct impact of foreign capital on domestic firms' export performance and is expected to be positive.

Apart from controlling for firm-level characteristics, some studies (e.g., Fu, 2011; Kneller and Pisu, 2007) also control for some industry-level variables, for example, R&D intensity in the industry and the industry export share, in order to control for the effects of comparative advantage resulting either from technology differences or from factor intensity in production at the industry level, and the possibility that FIEs choose to locate in more technologically advanced or export-intensive industries. In this paper, we include an industry dummy variable ( $D_j$ ) to control for such industry-specific effects. As a robustness check, we include the industry-level export share (*IEX*), defined as an industry's total export revenue divided by its total sales revenue, into the regression, which does not affect the estimated coefficients of FDI presence.

#### **4 Methodology and Model Specification**

There are three econometric problems to solve. The first problem results from the truncated dependent variable. Between 2000 and 2003, more than two-thirds of domestic firms in China's manufacturing industries were not exporting. Since these non-exporting domestic firms all share the value of zero for the dependent variable, the change in their ability to export due to FDI presence cannot be captured. Following Wooldridge (2002), we adopt the Heckman two-step procedure to include the non-exporting domestic firms into the regression. The method involves first assuming that domestic firms with similar characteristics may have similar exporting probabilities, and then estimating the inverse Mills ratio with a series of cross-sectional probit models to capture the probability that both exporting and non-exporting firms will choose to

export. In the second step, by adding the inverse Mills ratio into the regression, the impact of FDI on domestic firms' export performance, after controlling for the probability of both exporting and non-exporting firms choosing to export, can be estimated. To fulfil this two-step procedure, a dummy variable representing whether domestic firms do or do not export in the base year (say, year 2000) — which is highly related to domestic firms' exporting choice but not related to the amount of their exports — is used in the first step to identify the two regressions.

The second econometric problem is that of endogeneity. Unobserved and time-invariant and time-variant macro and firm-specific factors, such as the macroeconomic situation, openness to trade, development of local infrastructure, firms' entrepreneurship capabilities, and so on, affect not only domestic firms' export performance but also FDI inflows. The presence of endogeneity could bias the estimated impact of FDI on domestic firms' export performance. To solve the problem, we use first-differencing (FD) to eliminate the impact of time-invariant factors and an instrumental variable (IV) to eliminate the impact of time-variant factors. We refer to this method as the FDIV regression.

In the FDIV regression, following Haskel et al (2007) we use inward FDI into ASEAN countries' manufacturing industries as instruments for FDI presence in China's manufacturing industries. China and ASEAN countries have many similarities in attracting FDI inflows. For example, they are similar in terms of their level of economic development, are similar in terms of their economic and industrial structure, and have adopted similar trade and investment liberalisation policies. Previous studies (e.g., Chantasawat et al., 2004) find that there is a positive relationship between FDI inflows into China and FDI inflows into ASEAN countries, suggesting cross-industry variation in China's inward FDI is likely to be similar to the cross-industry variation in ASEAN countries' inward FDI. This strategy is based on the key assumption that FDI inflows into ASEAN countries do not directly impact productivity and, therefore, do not

impact the ability of China's domestic firms to export (Xu and Sheng, 2012). We use the share of FDI inflows into an industry over that industry's total output value in ASEAN countries as the instrumental variable for the horizontal FDI presence in the corresponding Chinese manufacturing industry. The backward or forward linkages in ASEAN countries' manufacturing industries are used as the instruments for downstream and upstream FDI presence in China's corresponding manufacturing industries.

The third problem to solve is that of selection bias relating to domestic firms' entry and exit. If we use a sample of only those domestic firms that are continuing (that is, a balanced panel), the estimated coefficients of FDI would be explained as only the impact of FDI on the surviving domestic firms' export performance. We choose instead to use an unbalanced panel data set, which allows for firms to exit and enter. However, we acknowledge that the use of an unbalanced panel may overestimate the impact of FDI, since non-exporting (or less productive) domestic firms may choose to exit the industry, while exporting (or more productive) domestic firms may choose to enter. We eliminate the outliers (top and bottom 5% of observations) and those with missing values from the sample and, as a result, the sample size in our empirical study contains 248,636 observations.

After dealing with the econometric issues discussed above, we use the following model specification to regress domestic firms' export performance on horizontal, downstream, and upstream FDI presence at the industry level with the control of other variables. Equation (4) refers to export performance.

$$\begin{aligned}
 dEXP_{ijrt} = & \beta_0 + \beta_1 dHorizontal_{jt} + \beta_2 dBackward_{jt} + \beta_3 dForward_{jt} \\
 & + \beta_4 d \ln TFP_{ijrt} + \beta_5 d \ln(K/L)_{ijrt} + \beta_7 dD\_Scale_{ijrt} \quad , \quad (4) \\
 & + \beta_8 dR \& D_{ijrt} + \beta_9 dIFI_{ijrt} + \gamma dMills_{ijrt} + \sum \alpha_t D_t + v_{ijrt}
 \end{aligned}$$

where  $d(\cdot)$  denotes the change of each variable over time,  $EXP_{ijrt}$  denotes the logarithm of export value ( $\ln Export_{ijrt}$ ) or the export-to-sales ratio ( $Expratio_{ijrt}$ ) of domestic firm  $i$  operating in industry  $j$ , region  $r$ , and time  $t$ , respectively.  $Horizontal_{jt}$  measures the

export spillovers generated by FDI presence in the same industry  $j$  in time  $t$ , and  $Backward_{jt}$  and  $Forward_{jt}$  measure the export spillovers generated by FDI presence in the downstream and upstream industries, respectively. The variables  $TFP_{ijrt}$ ,  $K/L_{ijrt}$ ,  $D\_Scale_{ijrt}$ ,  $R\&D_{ijrt}$ ,  $IFI_{ijrt}$  and  $\sum\alpha_r D_r$  are defined in section 3, and  $v_{ijrt}$  is used to capture random errors.  $Mills_{ijrt}$  in Equation (4) is the inverse Mills ratio, which has been estimated from the first-step probit model in equation (5):

$$P(d\_Export_{ijrt} = 1 | Export_{ijrt} > 0) = \theta_0 + \theta_1 Horizontal_{jt} + \theta_2 Backward_{jt} + \theta_3 Forward_{jt} + \lambda D\_Export_{ijrt-1} + \theta_4 \ln TFP_{ijrt} + \theta_5 \ln(K/L)_{ijrt} + \theta_6 OpenYear_{ijrt} + \theta_7 D\_Scale_{ijrt} + \theta_8 R\&D_{ijrt} + \theta_9 IFI_{ijrt} + \sum\phi_r D_r + \sum\phi_j D_j + v_{ijrt}, \quad (5)$$

and  $D\_Export_{ijrt-1}$  in equation (5) is domestic firms' export status before year  $t$  used to identify the first-step probit model for domestic firms' export ( $d\_Export_{ijrt} = 0,1$ ) (Heckman, 1979; Wooldridge, 2002; Christofides et al., 2003).  $OpenYear_{ijrt}$  is the firms' opening (establishment) year and the other variables are defined as in equation (4). Finally, two groups of dummy variables,  $\sum\phi_r D_r$  and  $\sum\phi_j D_j$ , are used to control for region (province) and industry effects.

All regressions have been adjusted for heteroscedasticity, and since all regressions are conducted between an individual-level dependent variable and some industry-level independent variables, following Moutlon (1990), the cluster effects have also been controlled at the industry level.

## 5 FDI and Domestic Firms' Export Performance

We present results first for export decisions and then for export performance. We then review the impact of different types of FIEs and the impact on different types of domestic firms in terms of their ownership structure.

### 5.1 The Impact of FDI Presence on Domestic Firms' Export Decisions

In Table 1, columns (1) to (3) present the cross-sectional estimations of the probit model for each year between 2001 and 2003, which are used to calculate the yearly inverse Mills ratio. The estimated coefficients of horizontal spillovers and backward spillovers

are positive and statistically significant at the 1% level and are consistent throughout the three years, suggesting positive knowledge spillovers from FIEs to domestic firms in the same industry and from FIEs to domestic firms in upstream industries in terms of the domestic firms' decisions to export. However, the estimated coefficients of the variable of forward spillovers of FIEs are negative and statistically significant at the 1% level and are consistent throughout the three years. In other words, the presence of FIEs in upstream industries has a negative impact on domestic firms in the downstream industries in terms of their decisions to enter the export market.

INSERT Table 1 Here

The positive horizontal spillovers from FIEs on the export decisions of domestic firms could be technology spillovers, export-related information spillovers, or both. In the case of technology spillovers, domestic firms may benefit from FIEs through imitation (reverse engineering) and human capital acquisition (labour movement). However, domestic firms also face strong competition from FIEs. The two effects may cancel each other out, so the net effect from technology spillovers may be insignificant. For export-related information spillovers, domestic firms can benefit from FIEs through the leakage or spillovers of information relating to export market intelligence, international marketing know-how, and export operations. Accordingly, the positive horizontal knowledge spillovers from FIEs to domestic firms in terms of the domestic firms' decisions to export are probably related to export information.

The positive backward spillovers from FIEs to domestic firms in the upstream industries in terms of the domestic firms' decisions to export are expected to be technology spillovers. Because export-related information spillovers are mainly product and industry specific, there would be few export-related information spillovers from FIEs to domestic firms in the upstream and downstream industries. However, FIEs may transfer technology to their local suppliers of raw materials and intermediate inputs,

thus improving domestic firms' productivity and competitiveness and increasing the probability that they will enter the export market.

The negative forward spillovers from FIEs on domestic firms in the downstream industries in terms of such domestic firms' decisions to enter the export market deserve more explanation. Because of differences in product quality standards, lack of compatibility in technology levels, and costs of doing business, FIEs in China are most likely to sell their intermediate products to either other FIEs or the international market rather than to domestic firms in the downstream industries. As a result, domestic firms face strong competition from FIEs in the same downstream industries, thus negatively affecting domestic firms' decisions to enter the export market.

For the control variables, in all regressions, the estimated coefficient of the past export status variable is positive and statistically significant at the 1% level, suggesting the importance of past export experience in firms' current export decisions. The estimated coefficient of domestic firms' TFP is positive and statistically significant at 1% and 5% levels, indicating the significant role played by firms' productivity in their export decisions. The estimated coefficient of the capital-labour ratio is negative and statistically significant at the 1% level, indicating that comparative advantage based on labour-intensive activities is an important determinant influencing domestic Chinese firms' decisions to export. As for other control variables: firms with greater innovation ability are more likely to export; older firms having operated for longer periods are more likely to export; firms with indirect foreign investment are more likely to export; while larger firms appear to be less likely to enter the export market.

### *5.2 The Impact of FDI Presence on Domestic Firms' Export Performance*

Table 2 reports the FDIV estimation results (the first stage IV regression results are available on request). Column (1) of Table 2 reports the estimated impact of FIEs on domestic firms' export performance as measured by export value. The estimation results show that FDI may raise domestic firms' export values mainly in the upstream

industries. The estimated coefficient of the variable of backward spillovers is significant at the 1% level. This suggests that FIEs have backward technology spillovers on domestic firms, which improve the upstream domestic firms' productivity, thus increasing their export competitiveness. An explanation could be that the entry of FIEs generates demand from the upstream industries. To secure high-quality inputs, FIEs may transfer certain technology to upstream domestic suppliers, which will improve the productivity and increase the export competitiveness of domestic firms. The results also show that FIEs have a positive impact on the export values of domestic firms' in the same industry but that this effect is only marginally significant at the 10% level. This indicates that although FIEs may generate technology spillovers on domestic firms in the same industry through demonstration effects and labour movement, domestic firms also face strong competition from FIEs. As a result, the net effect from technology spillovers of FIEs on domestic firms in the same industry is weak. However, the results show that FIEs have no significant impact on the export values of domestic firms' in the downstream industries. In other words, FIEs generate no forward technology spillovers on domestic firms.

INSERT Table 2 Here

As for the control variables, factors that significantly affect a domestic firm's export values are the same as those in the export decision regression. Domestic firms' export values are positively related to their productivity and R&D activities. Domestic firms' export values are negatively related to their capital-labour ratio and scale. Indirect foreign investment is a positive and statistically significant factor explaining domestic firms' export values. Finally, the significant coefficient of the inverse Mills ratio suggests that the sample selection problem does matter for the regression. Thus, the adjustment with the Heckman selection is appropriate.

Column (2) of Table 2 reports the estimated impact of FIEs on domestic firms' export performance as measured by domestic firms' export-to-sales ratios. The

estimation results show that FDI may raise the export-to-sales ratios of domestic firms in the same industry. The estimated coefficient of the horizontal spillovers variable is statistically significant at the 1% level. This suggests that FIEs have horizontal export-related information spillovers on domestic firms. The estimation results also show that FDI has no significant impact on domestic firms' export-to-sales ratios through backward and forward industrial linkages.

For the control variables, the results are roughly the same as in the export value regression, with only one exception. The variable of productivity (TFP) is statistically insignificant. Comparing this to the results in the export value regression, where productivity has a positive and significant impact on domestic firms' export values, the insignificance of the impact of productivity on domestic firms' export-to-sales ratios suggests that improving productivity can increase a firm's export value and export competitiveness, but may not increase its export-to-sales ratio and export market orientation.

We conduct two robustness checks. First, we add the industry export share into the regressions. Second, we use only the 100% domestically-owned firms as the sample and re-do all regressions to test the impact of FIEs on these domestic firms' export decisions and export performance. The robustness check (results available on request) finds that our estimation of the impacts of FIEs on domestic firms' export performance measured both by export value and by export-to-sales ratio is consistent for different samples and choices of controlled variables.

### *5.3 The Impact of Different Types of FIEs on Domestic Firms' Export Performance*

FIEs in China have two notable features. One feature is their high propensity to export; during the sample period, 2000 to 2003, FIEs' average export-to-sales ratio was 42%. The other feature is their high involvement in processing trade. Processing trade activities include 'processing or assembling with imported materials' and 'processing or assembling with supplied materials'. During the same period, the average share of FIEs'

processing exports was 80% of FIEs' total exports. Therefore, it is important to investigate how FIEs with different market orientations will affect domestic firms' export performance. The strength, the channels (horizontal or vertical), and the ways (technology or export-related information) that export spillovers from FDI may take place might be determined by FIEs' type. To do so, we group FIEs into exporting FIEs (those whose current export revenue is greater than zero) and non-exporting FIEs (those whose current export revenue is equal to zero). We also identify high-exporting FIEs (those whose current export revenue is greater than or equal to 50% of total revenue). Equations (1) to (3) are used to calculate the corresponding horizontal, backward, and forward FDI spillovers variables for each group of FIEs. The estimation results are shown in Table 3 and they confirm our expectations. In all these estimations (also in section 5.4), the first-step probit model regressions on domestic firms' decisions to export are conducted to produce the inverse Mills ratio. These are not reported and we will focus the analysis on the second-step Heckman selection regressions (the first-step estimation results are available from the authors upon request).

INSERT Table 3 Here

Columns (1) and (2) of Table 3 show that exporting FIEs have a positive and statistically significant impact on domestic firms' export values through backward linkages and a positive and statistically significant impact on the export-to-sales ratios of domestic firms in the same industry, which confirms our expectation (a).

Columns (3) and (4) of Table 3 show that high-exporting FIEs have no impact on domestic firms' export values but have a positive and statistically significant impact on the export-to-sales ratios of domestic firms in the same industry, which confirms our expectation (b).

Columns (5) and (6) of Table 3 show that non-exporting FIEs have a positive and statistically significant impact on domestic firms' export values through backward linkages. Non-exporting FIEs have no impact on domestic firms' export-to-sales ratios

because they do not engage in export activities so they have no export-related information spillovers. The results confirm our expectation (c).

The above empirical estimation results reveal that FIEs with different market orientation have different impacts on domestic firms' export performance. Exporting, particularly high-exporting, FIEs have positive and significant impacts on domestic firms' export-to-sales ratios, and this occurs through horizontal export-related information spillovers that reduce the export marketing costs and increase the export market orientation of domestic firms in the same industry. Both exporting and non-exporting FIEs have positive and significant impacts on domestic firms' export values through backward technology spillovers that improve the productivity and increase the export competitiveness of domestic firms in the upstream industries. It is also interesting to note that there are no forward knowledge spillovers from any kind of FDI to domestic firms.

#### *5.4 The Impact of FDI on the Export Performance of Different Types of Domestic Firms*

Will domestic firms' own characteristics influence the impact of FIEs presence on domestic firms' export performance? To answer this question, we divide our sample of domestic firms into two categories based on their ownership: one comprises SOEs (comprising those firms with a share of capital owned by state and collective groups of more than 50%) and the other comprises non-SOEs.

For domestic SOEs, , because of their ownership nature, there will be less business contact and industry linkages between domestic SOEs and FIEs. Therefore, FIEs is more likely to have horizontal technology spillovers on domestic SOEs in the same industry if there are any knowledge spillovers from FIEs. In contrast, domestic non-SOEs have more incentive to learn from FIEs and may have more business contact and industry linkages with FIEs (for example, through supplying raw materials and intermediate inputs to FIEs) and thus have more backward and forward export spillovers from FIEs.

The results in Table 4 confirm these expectations. Columns (1) and (2) of Table 4 show that FIEs have a positive impact on the export values of domestic SOEs in the same industry but that the effect is statistically significant only at the 10% level. This suggests that domestic SOEs benefited from FIEs only marginally through horizontal technology spillovers. In contrast, Columns (3) and (4) of Table 4 show that FIEs have a positive and statistically significant impact on domestic non-SOEs' export values through backward linkages and a positive and statistically significant impact on the export-to-sales ratios of domestic non-SOEs in the same industry. This suggests that FDI knowledge spillovers on domestic Chinese firms' export performance are mainly transferred through backward technology spillovers and through horizontal export-related information spillovers to domestic non-SOEs.

INSERT Table 4 Here

## **6 Conclusion**

The effects of FDI on domestic firms' export performance are less studied in the literature compared to spillovers to productivity. To close this gap, this paper examines how and to what extent FDI influences the international competitiveness and export market orientation of domestic firms using firm-level census data of Chinese manufacturing industries over the period 2000–03. Significant positive export spillovers have been identified mainly through either horizontal or backward industrial linkages. The paper finds that the positive impact on domestic firms' export values through backward technology spillovers occurs from non-exporting FIEs while the positive impact on domestic firms' export-to-sales ratios through horizontal export-related information spillovers is mainly from the group of high-exporting FIEs. Both export spillovers are mainly beneficial to domestic non-SOEs.

The paper makes three contributions to the literature. First, it investigates not only the intra-industry (horizontal) but also the inter-industry (vertical) impact of FDI export spillovers on domestic export performance. Second, export performance is

assessed in terms of both export competitiveness (as measured by the firms' export values) and export market orientation (as measured by the firms' export-to-sales ratios). Third, FDI spillovers are linked to FIEs' market orientation and domestic firms' ownership type. The findings of this study raise two important policy implications. First, since export spillovers are weak from export-oriented FIEs, FDI attraction policy could be adjusted to enhance technology spillovers from FDI. Second, non-SOEs are the main beneficiaries of knowledge spillovers from FDI and slow reform of SOEs limits the diffusion of knowledge spillovers from FDI.

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**Table 1 Impact of FDI on domestic firms' export decision (probit model)**

	2001 (1)	2002 (2)	2003 (3)
<b>lnTFP</b>	0.134*** (0.029)	0.042** (0.021)	0.059*** (0.016)
<b>ln(K/L)</b>	-0.033*** (0.007)	-0.051*** (0.006)	-0.066*** (0.005)
<b>D_Scale</b>	-0.374*** (0.024)	-0.300*** (0.022)	-0.421*** (0.021)
<b>R&amp;D</b>	0.606*** (0.055)	0.628*** (0.046)	0.550*** (0.047)
<b>OpenYear</b>	0.001** (0.001)	0.006*** (0.001)	0.011*** (0.001)
<b>IFI</b>	1.728*** (0.239)	1.659*** (0.219)	1.416*** (0.223)
<b>Horizontal</b>	3.471*** (0.338)	2.204*** (0.222)	1.800*** (0.184)
<b>Backward</b>	4.259***	3.519***	3.015***

	(0.389)	(0.266)	(0.251)
<b>Forward</b>	-7.817***	-6.344***	-4.807***
	(1.002)	(0.804)	(0.712)
<b>Previous Export Dummy</b>	2.672***	3.092***	3.476***
	(0.018)	(0.020)	(0.023)
<b>Constant</b>	-7.781***	-15.287***	-25.345***
	(1.203)	(1.103)	(1.146)
<b>Number of Observations</b>	70,076	88,519	92,415
<b>Adjusted R squared</b>	0.630	0.572	0.568

Note: Region and industry dummies are controlled and jointly significant in each regression. For concision, they are not reported. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1, and numbers in parentheses are standard error.

**. Table 2 Impact of FDI on domestic firms' export performance (FDIV regression)**

Variables	Export value	Export ratio
	(1)	(2)
<b>lnTFP</b>	0.121***	-0.001
	(0.037)	(0.005)
<b>ln(K/L)</b>	-0.027**	-0.002***
	(0.012)	(0.000)
<b>D_Scale</b>	-0.072***	-0.007*
	(0.024)	(0.004)
<b>R&amp;D</b>	0.108*	0.035***
	(0.059)	(0.013)
<b>Mills</b>	-0.322***	-0.037***
	(0.029)	(0.005)
<b>IFI</b>	1.053***	0.046***
	(0.265)	(0.013)
<b>Horizontal</b>	1.935*	0.069***
	(1.166)	(0.016)
<b>Backward</b>	5.698***	0.549
	(1.307)	(0.400)
<b>Forward</b>	6.861	1.990
	(7.227)	(1.317)
<b>Constant</b>	0.020	-0.013*
	(0.031)	(0.007)
<b>Number of observations</b>	21,330	21,330
<b>Adjusted R squared</b>	0.005	0.007

Note: Time dummies are controlled and jointly significant in each regression. For concision, they are not reported. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1, and numbers in parentheses are standard error.

**Table 3 Impact of FIEs with different market orientation (FDIV regression)**

	Exporting FIEs		High-exporting FIEs		Non-exporting FIEs	
	Export value	Export ratio	Export value	Export ratio	Export value	Export ratio
	(1)	(2)	(3)	(4)	(5)	(6)
<b>lnTFP</b>	0.056*	0.010	0.091***	0.003***	-0.177	0.008
	(0.031)	(0.016)	(0.028)	(0.000)	(2.480)	(0.044)
<b>ln(K/L)</b>	-0.033**	-0.001	-0.029**	-0.002	-0.046***	-0.002
	(0.014)	(0.003)	(0.011)	(0.002)	(0.015)	(0.003)
<b>D_Scale</b>	-0.121***	-0.001	-0.080***	0.006	-0.015***	0.006
	(0.009)	(0.018)	(0.022)	(0.004)	(0.008)	(0.014)
<b>R&amp;D</b>	0.105*	0.033**	0.116**	0.034***	0.047***	0.036***
	(0.061)	(0.016)	(0.058)	(0.013)	(0.130)	(0.002)
<b>Mills ratio</b>	-0.322***	-0.035***	-0.319***	-0.036***	-0.464	-0.035*
	(0.037)	(0.008)	(0.029)	(0.005)	(1.124)	(0.018)
<b>IFI</b>	1.164***	0.018	1.057***	0.042***	1.658***	-0.041
	(0.431)	(0.078)	(0.270)	(0.004)	(0.466)	(0.093)
<b>Horizontal</b>	2.385	1.337***	9.596	0.541***	1.344	-0.687
	(9.761)	(0.216)	(8.930)	(0.083)	(1.089)	(1.783)
<b>Backward</b>	1.477***	-1.737	6.184	1.626	4.562***	6.712
	(0.210)	(10.658)	(4.753)	(4.481)	(0.596)	(8.940)
<b>Forward</b>	-12.955	-26.575	8.286	9.855	-2.131	7.878

	(25.182)	(54.453)	(6.719)	(7.258)	(1.838)	(31.519)
<b>Constant</b>	-0.035	-0.028	-0.015	-0.008	-0.084	-0.027
	(0.270)	(0.051)	(0.059)	(0.006)	(1.705)	(0.026)
<b>Number of observations</b>	21,330	21,330	21,330	21,330	21,330	21,330
<b>Adjusted R squared</b>	-0.170	-0.178	0.009	0.005	-0.335	-0.012

Note: Time dummies are controlled and jointly significant in each regression. For concision, they are not reported. The first stage IV regressions for the three groups: under-identification test statistics (Kleibergen-Paap rk LM statistic) are 15.61, 13.42, and 17.15; weak identification test statistics (Cragg-Donald Wald F statistics) are 273.4, 372.1, and 157.5; and weak identification test statistics (Kleibergen-Paap Wald F test) are 12.3, 16.4, and 15.1. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 and numbers in parentheses are standard error.

**Table 4 Impact of FIEs on SOEs' and non-SOEs' export performance (FDIV regression)**

	SOEs		Non-SOEs	
	Export value (1)	Export ratio (2)	Export value (3)	Export ratio (4)
<b>lnTFP</b>	0.140** (0.057)	0.001 (0.008)	0.121*** (0.036)	-0.000 (0.006)
<b>ln(K/L)</b>	-0.029 (0.022)	-0.001** (0.000)	-0.028*** (0.011)	-0.003** (0.001)
<b>D_Scale</b>	-0.026 (0.038)	-0.012** (0.005)	-0.080*** (0.028)	-0.006*** (0.002)
<b>R&amp;D</b>	-0.009 (0.108)	-0.010 (0.017)	0.145** (0.065)	0.048*** (0.015)
<b>Mills ratio</b>	-0.283*** (0.047)	-0.024** (0.009)	-0.328*** (0.033)	-0.041*** (0.006)
<b>IFI</b>	0.972** (0.492)	0.081 (0.107)	1.096*** (0.365)	-0.090 (0.065)
<b>Horizontal</b>	2.926* (1.539)	0.144 (0.184)	1.647 (1.080)	0.170*** (0.020)
<b>Backward</b>	5.511 (5.115)	0.533 (0.606)	5.993** (2.674)	0.498 (0.425)
<b>Forward</b>	19.467 (13.922)	1.479 (1.384)	4.097 (5.662)	2.250 (1.368)
<b>Constant</b>	-0.082* (0.047)	-0.012** (0.006)	0.047* (0.028)	-0.014* (0.007)
<b>Number of observations</b>	5,610	5,610	15,720	15,720
<b>Adjusted R squared</b>	-0.059	-0.008	0.015	0.002

Note: Time dummies are controlled and jointly significant in each regression. For concision, they are not reported. The first stage IV regressions for the two groups: under-identification test statistics (Kleibergen-Paap rk LM statistic) are 14.1 and 12.7; weak identification test statistics (Cragg-Donald Wald F statistics) are 245.6 and 148.2; and weak identification test statistics (Kleibergen-Paap Wald rk F statistic) are 15.7 and 16.56. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1 and numbers in parentheses are standard error.